522 Rec'd PCT/PTO 10 JAN 2001

U S DEPARTMENT OF COMMERCE, PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER
33910R002

U.S. APPLICATION NO. (if known, see 37 CFR 1.5) 09/743476

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/FR99/01693	July 9, 1999	July 10, 1998

TITLE OF INVENTION
SYSTEM FOR LOCATING MOBILE TELEPHONES

APPLICANT(S) FOR DO/EO/US ---- François CASEAU

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ■ This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.

2. □ This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.

3. ■ This express request to begin national examination procedures (35 U.S.C. 371(f) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(l).

4. ■ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.

5. ■ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. □ is transmitted herewith (required only if not transmitted by the International Bureau)b ■ has been transmitted by the International Bureau (see Form 308) c. □ is not required, as the application was filed in the United States Receiving Office (RO/US).

6. ■ A translation of the International Application into English (35 U.S.C. 371(c)(2)) (including translated text in formal drawings)

7. ■ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a.□ are transmitted herewith (required only if not transmitted by the International Bureau)
   b. □ have been transmitted by the International Bureau.
   c. □ have not been made; however, the time limit for making such amendments has NOT expired.
   d.■ have not been made and will not be made.

8. □ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).

9. ■ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).

10. □ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ■ An Information Disclosure Statement under 37 CFR 1.97 and 1.98. (w/ copy of PTO-1449 and each reference cited therein and Int'l Search Rept)

12. □ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.

13. ■ A FIRST preliminary amendment.
    □ A SECOND or SUBSEQUENT preliminary amendment.

14. □ A substitute specification.

15. □ A change of power of attorney and/or address letter.

16. ■ Other items or information:

a) Form PCT/IB/308
b) Form PCT/IB/332
c) PCT Request (Form PCT/RO/101)
d) Form PCT/IB/301
e) Form PCT/IB/304
f) Form PCT/IPEA/416 (Notification of Transmission of International Preliminary Examination Report)
g) Form PCT/IPEA/409 (Preliminary Examination Report)
h) Verification of translator of PCT application
i) Copy of PCT Publ. WO 00/03556 with attached French and English Language International Search Report (PCT/ISA/210)

U S DEPARTMENT OF COMMERCE, PATENT AND TRADEMARK OFFICE JC07 Rec'd PCT/PTO 10 JAN 2001

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371	ATTORNEY'S DOCKET NUMBER 33910R002
	U.S. APPLICATION NO. (if known, see 37 CFR 1.5) 09/743476

17. ■ The following fees are submitted:				CALCULATION	PTO USE ONLY
Basic National Fee (37 CFR 1.492(a)(1)-(5)): Search Report has been prepared by the EPO or JPO . . . . . $860.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) . . . . . $670.00 No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2) . . . . . $760.00 Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO . . . . . $970.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) $96.00					
ENTER APPROPRIATE BASIC FEE AMOUNT =				$860.00	
Surcharge of $130.00 for furnishing the oath or declaration later than □ 20 □ 30 months from the earliest claimed priority date (37 CFR 1.495(e)).				$ -	
Claims	Number Filed	Number Extra	Rate		
Total Claims	13 - 20 =	0	x $18.00	$ -	
Independent Claims	1 - 3 =	0	x $80.00	$ -	
Multiple dependent claim(s) (if applicable)			+ $260.00	-	
TOTAL OF ABOVE CALCULATIONS =				$ 860.00	
Reduction by ½ for filing by small entity, if applicable.				$43 0.00	
SUBTOTAL =				$ 430.00	
Processing fee of $130.00 for furnishing the English translation later than □ 20 □ 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$ -	
TOTAL NATIONAL FEE =				$ 430.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property. +				$	
TOTAL FEES ENCLOSED =				$ 430.00	
				Amount to be refunded	$
				charged	$

a. ■ A check in the amount of $ 430.00 to cover the above fees is enclosed.
b. □ Please charge my Deposit Account No. 02-4300 in the amount of $___ to cover the above fees. A duplicate copy of this sheet is enclosed.
c. ■ The Commissioner is hereby authorized to charge any additional fees which may be required with respect to any deficiency in the above noted "Basic National Fee", or credit any overpayment to Deposit Account No. 02-4300 .

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

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Date: January 10, 2001

09/743476

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Atty. Docket No. 33910R002

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): François CASEAU

International PCT Application No.: PCT/FR99/01693

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Filed: : January 10, 2001 (Herewith) | Examiner: To Be Assigned

For : SYSTEM FOR LOCATING MOBILE TELEPHONES

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to or concurrent with calculation of the filing fees, please amend this application as follows.

IN THE CLAIMS:

Please amend the claims as follows.

Claim 3, line 1, change "either preceding claim" to --claim 1--.

Claim 4, line 1, change "any preceding claim" to --claim 1--.

Claim 5, line 1, change "any preceding claim" to --claim 1--.

Claim 6, line 1, change "any preceding claim" to --claim 1--.

Claim 7, line 1, change "any preceding claim" to --claim 1--.

Claim 8, line 1, change "any preceding claim" to --claim 1--.

Claim 9, line 1, change “any preceding claim” to --claim 1--.

Claim 10, line 1, change “any preceding claim” to --claim 1--.

Claim 13, line 1, change “any of claims 10 to 12” to --claim 10--.

REMARKS

Entry and consideration of this Preliminary Amendment courteously are solicited prior to or concurrent with calculation of the filing fees. This Preliminary Amendment is being filed to remove all multiple dependent claims to avoid the surcharge.

Examination on the merits is awaited.

Respectfully submitted,

SMITH, GAMBRELL & RUSSELL, LLP

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JC07 Rec'd PCT/PTO 10 JAN 2001

System for locating mobile telephones.

The present invention relates to digital cellular radio communication with mobile stations, for example in accordance with the GSM (Global System for Mobile communications) standard.

The invention relates more particularly to a system for locating mobile stations communicating by means of a fixed receiver terminal which is part of a network.

This type of system generally employs time division multiplexing which entails dividing time into frames of fixed and predetermined duration. The frames are in turn divided into time slots. This technique is known as time division multiple access (TDMA). A particular time slot recurring in each frame constitutes a physical channel. This structure is used both for the uplink from a mobile station to a receiver terminal and for the downlink from a receiver terminal to a mobile station. The data exchanged by a mobile station and a receiver terminal is transmitted in the form of packets, each of which is placed in one time slot. The various logical channels, for example traffic channels (TCH) and control channels, are multiplexed onto the physical channels. Consequently, the time slots of a given physical channel are divided between a plurality of logical channels, which produces a new structure known as a multiframe.

The GSM communication protocol is described in the book "The GSM System for Mobile Communications" by M. Mouly and M-B. Pautet, 1992, the content of which is hereby incorporated herein by reference.

With regard to the GSM protocol, the mobile telephone network knows roughly where a mobile station on standby is located in real time, in the sense that it knows the reception area with which the mobile station is communicating at its current location. The reception area is represented by a plurality of contiguous receiver

terminals. If the mobile station leaves a sector served by one reception area it transmits an update message to indicate the change to the network. A mobile station can be called at any time because the network knows its location. Moreover, the network knows the cell global identifier (CGI) of the cell that a communicating mobile station is logged onto, a cell being a portion of terrain served by the same radio terminal.

At given time intervals a communicating mobile station transmits a measurement report message to the receiver terminal it is logged onto on a service radio channel (SACCH). This information enables the network to choose the best receiver terminal to carry the call with the mobile station at all times.

Knowing the time to cover the distance between the mobile station and the radio terminal, which is known as the timing advance (TA), the mobile station can transmit to the radio terminal at a time chosen so that said radio terminal is able to receive the transmission from the mobile station without interference from transmissions by other mobile stations. The timing advance TA therefore reflects the distance to be travelled by the radio wave between the mobile station and the radio terminal. A unity increment of the timing advance TA corresponds to a distance of approximately 550 metres.

The measurement report message transmitted by the mobile station to the radio terminal includes a parameter RXLEV which corresponds to the level at which the mobile station receives from the radio terminal with which it is communicating and up to six of the best adjoining receiver terminals. The measurement report message also includes a parameter RXQUAL which corresponds to the quality of reception by the mobile station from the radio terminal with which it is communicating.

A short message service (SMS) enables the

transmission and reception of text messages between a mobile station and the network, either on the SACCH if the mobile station is communicating or on the signalling channel (TCH/8 or SDCCH) if the mobile station is on standby. The mobile telephone carrier can employ a radio planning tool to calculate the reception level and quality at a given geographical point as a function of the geographical location of the radio terminal, adjoining radio terminals, their transmit power, their type, the frequencies used, etc.

The phase 2 + GSM 11.11 and GSM 11.14 technical specifications specify the interface between a mobile equipment and the SIM card of a subscriber. In particular, a SIM card can request a measurement report from a mobile equipment, instigate the transmission of SMS short messages and store the content of incoming SMS messages. This is known in the art.

EP-A-0 398 773 describes a method for determining the geographical location of a mobile station in a time division multiple access communication network, the method including the steps of transmitting to a first fixed station a value measured at the mobile station of the relative phase of synchronization signals received from the first fixed station and at least one second fixed station, measuring at the first fixed station the propagation time of the synchronization signal from the first fixed station to the mobile station and the relative phase with which the BCCH is received, calculating at the first fixed station synchronization signal propagation times from the second fixed station to the mobile station using the previously stored transmission relative phase, and calculating the position of the mobile station from the propagation times and the geographical co-ordinates of the first and second fixed stations.

WO 9635306 describes a method of determining the

location of a mobile station of a cellular radio system including a plurality of base stations. The time differences between transmissions from the base stations as measured by the mobile unit are determined. The distances between the mobile station and each of the base stations is determined from these time differences. The location of the mobile unit is deduced from these distances. The time division structures of the control channels of at least some of the base stations which are within range of the mobile station are synchronized and said mobile station determines the time differences of a characteriztic element of the time division structure broadcast on the control channel of each base station. If the number of base stations detected by the mobile station is too low, the timing advance required for communication with the server base station is used to deduce the distance between the mobile station and the server base station.

However, the various methods that have been proposed enable location of the mobile station unknown to its user and are cumbersome and expensive to implement.

An object of the present invention is to propose a system in which a mobile station can be located only at the command of its user or using an ad hoc SIMToolkit application. The SIMToolkit applications can instigate the automatic transmission of short messages. The SIMToolkit applications can transmit these messages only when a specific telephone number is entered.

Another object of the present invention is to propose a system for locating mobile stations that does not require any modification of the GSM protocol.

The location system in accordance with the invention is intended for mobile stations able to communicate with a first radio terminal of a network of radio terminals supervised by an operational control centre.

The mobile station includes means for estimating at least one parameter representative of the position relative to a radio terminal and means for transmitting information relating to said parameter to a server via the first radio terminal.

The server includes means for comparing the information relating to said parameter to a predefined map of said parameter and deducing from the result of such comparison an estimate of the location of the mobile station.

In one embodiment of the invention, the system includes means for estimating the distance between a mobile station and the first radio terminal with a margin of error Δd_{bm} as a function of the time taken by a wave to cover said distance.

In one embodiment of the invention the system includes means for estimating the levels of reception from the first radio terminal and adjoining radio terminals.

In one embodiment of the invention the system includes means for estimating the quality of reception of transmissions from the first radio terminal and advantageously from adjoining radio terminals.

The mobile station advantageously includes means for comparing the times r_i of reception by the mobile station of transmissions from other radio terminals at times r of reception of transmissions from the first radio terminal and deducing therefrom the value Δr_i of the receive time shift and means for transmitting the value of each time shift Δr_i to the server via the first radio terminal and the server advantageously includes means for estimating the distance between the mobile telephone and each of the other radio terminals as a function of the time shift Δr_i and the time shift Δe_i between the transmission times e_i of the other radio terminals and the transmission times e of the first radio terminal.

In one embodiment of the invention the system includes means for specifying the location of the mobile telephone by cross-checking the estimated locations obtained using at least two parameters.

Location can be effected at the command of the mobile station user.

The server can include means for transmitting information to the user as a function of the location of the mobile telephone. That information can comprise either audio messages or messages for display.

Because information is transmitted between a mobile station and a radio terminal on a service logical channel and on a traffic logical channel, the information relating to said parameter is advantageously transmitted to the first radio terminal on the traffic logical channel, for example using the short message service.

The map can be adapted to the transmit power levels of the various radio terminals by linear interpolation.

The map can be recomputed as a function of changes in parameters likely to modify the values relayed to the geographical information server, for example as a function of activation or non-activation of frequency hopping on the various radio frequencies.

The map can be recomputed as a function of activation or non-activation of enhanced full rate (EFR) on the various radio frequencies.

The map can be recomputed as a function of the transmit power levels of the various radio terminals, a change to the topology of the stored maps, for example due to the construction of a building, and activation of frequency hopping.

In one embodiment of the invention the parameter representative of the position is the parameter NB-correlation corresponding to the number of correlations to the BCCH frequency.

The mobile station can be provided with means for comparing location data with a previously stored area, for the purposes of special rate charging, for example for calls near the user's home, with the location data being stored in a SIM card of the mobile station.

The mobile station can include means for transmitting charging data by means of the short message service.

In one embodiment of the invention the mobile station transmits charging data if a call is made or received in the vicinity of the previously stored area if the mobile station enters or leaves said previously stored area during a call.

In one embodiment of the invention, the mobile station includes means for transmitting a "transfer to fixed network" message if said mobile station is in the previously stored area, causing modification of call routing so that any incoming call is notified to the fixed station or stations and to the mobile station.

In a system of the above kind a mobile station can be used for many purposes, for example to transmit a distress signal or to provide the user with information relating to their location. The user can therefore communicate with a database containing geographical information for navigation or tourist information including commentaries on what the user can see from their location. This communication with a database can be effected by means of a dedicated telephone number that does not change with the location. The language in which the information is supplied to the user can also be selected, either automatically on the basis of the information transmitted to the location server or at the command of said user; alternatively, it can be associated with the telephone number.

The present invention will be understood better

after reading the following detailed description of a few embodiments of the invention, provided by way of non-limiting example and shown in the accompanying drawings, in which:

figure 1 is a diagram showing the operation of a mobile telephone network according to the invention;

figure 2 is a variant of figure 1;

figure 3 is a diagram showing the capture of the number of correlations of a radio wave in the geographical information server; and

figure 4 is a diagram showing the capture of a particular time profile.

In the following description, the expression "mobile equipment" refers to a "blank" mobile telephone with no operational SIM card inserted into it. A mobile equipment can transmit only emergency calls.

The function of a SIM (Subscriber Identity Module) card is to identify a subscriber to a given mobile network.

A mobile station is the combination of a mobile equipment and a SIM card. A mobile station can transmit and receive telephone calls.

A services logical channel conveys all the information needed for correct operation of a mobile network: transmission of calls, reception of calls, handover, etc.

A services channel uses various types of physical channels, such as the BCCH and the SDCCH.

The information transmitted on a services logical channel is managed by the mobile telephone carrier's infrastructure.

As opposed to services logical channels, a traffic logical channel conveys information addressed to the correspondent of the mobile subscriber. A traffic logical radio channel uses one or more physical channels such as the TCH or SDCCH (TCH/8), or half a TCH if the telephone

carrier has implemented the half rate option. Note that the SDCCH (TCH/8) is a physical channel that can carry service information or traffic information. The information carried on a traffic channel is not addressed to the mobile telephone carrier and is charged for. It can be audio information or "data" information intended to be displayed: short messages service (SMS) messages, unstructured supplementary services data (USSD) or global packet radio switch (GPRS) messages.

The GPRS radio communication protocol governs the transmission of data in accordance with the Internet protocol (IP) via a GSM telephone infrastructure.

The GPRS is interfaced between the IP communication layer and the physical layer of the ISO model.

The GPRS therefore enables a mobile station to communicate in the IP format: access to Internet servers, transmission + reception of electronic mail, etc.

The expression "fixed/mobile convergence" refers to all techniques enabling fixed and mobile telephone subscriptions to be harmonised and possibly merged.

This is to offer the advantages of the fixed telephone in the home, in particular in terms of speech quality and high bit rate, in conjunction with user mobility.

Other advantages associated with fixed/mobile convergence are single billing, differentiation of call charges according to the place from which the call was made, and possibly the use of the same telephone handset.

Figure 1 shows that the mobile telephone network includes a plurality of radio systems 1 each including a plurality of transmit and receive terminals, not shown, referred to as radio terminals, each adapted to communicate with a plurality of mobile stations, not shown. Each radio system 1 is connected to an operational control centre 2. Each operational control centre 2 manages a plurality of

radio systems 1. The operational control centres 2 are in turn connected to a network management centre 3. The network management centre is connected to a geographical information server 4 adapted to exchange information with a radio planning tool 5 and with a mobile switching centre 6 which provides an interface to a landline telephone network, not shown.

Figure 2 shows a variant in which the operational control centres 2 are connected directly to the geographical information server 4.

For the geographical information server 4 to be able to compute the position of a mobile station it is necessary to relay information from the mobile station to the geographical information server 4. The traffic logical channel is used to transmit location parameters to the geographical information server 4. The geographical information server 4 is able to receive messages on the speech channel in the short message service (SMS) format or in the IP format (when the information is transmitted by the mobile station in the GPRS format).

The service information that the mobile station can transmit to the geographical information server 4 is made up of parameters assisting location:

- the server cell's cell global identifier (CGI),
- the binomials BSIC, BCCH of the cells adjoining the server cell, the mobile station relaying this information for all the BCCH that it is capable of interpreting, the number of which can exceed six,
- the parameter RXLEV relating to the reception levels from all the aforementioned cells,
- the parameter RXQUAL relating to the reception quality from the server cell and advantageously from adjoining cells,
- the reception time difference (DIR) for all the aforementioned cells,

- the NB-correlation parameter indicating the number of correlations with the BCCH frequency for the aforementioned cells,

- the reception time difference (DTR) for the synchronization bursts (SCH) of each of the aforementioned cells, and a parameter associated with the time that has elapsed since the beginning of measurements by the mobile station, and

- a parameter related to the distance from the server radio station.

The cell global identifier (CGI) parameters and the binomials BSIC and BCCH are the most useful for locating the mobile station. These parameters identify the cells involved in locating the mobile station. They are already known and processed by the mobile station and it is therefore a simple matter for the mobile station to transmit them to the geographical information server 4.

In particular cases, and especially for emergency calls, the mobile station can transmit service information concerning cells of another mobile telephone network. The GSM 05.08 ETS 300578 recommendations specify that a mobile station must be able to scan all GSM frequencies to identify BCCH frequencies in order to compute their receive level. In this case, the geographical information server 4 knows the locations of the cells of the various networks and therefore knows which cells adjoin a given cell.

In the remainder of this description the messages containing the information needed for geographical location are referred to as "location measurement messages".

A mobile station already computes the RXLEV parameter for the carrier frequency (RXLEV-FULL-SERVING-CELL and RXLEV-SUB-SERVING-CELL) and the BCCH frequencies of the adjoining cells (RXLEV-NCELL) and the RXQUAL parameter for the carrier frequency (RXQUAL-FULL-SERVING CELL and RXQUAL-SUB-SERVING-CELL).

The mobile station can advantageously compute the parameter RXQUAL from the BCCH frequencies of adjoining cells.

Moreover, to harmonise the measurements relayed to the geographical information system 4, the parameters RXLEV and RXQUAL for the server frequency can be computed only from the BCCH multiframe instead of from some or all of the TDMA frames. However, there remain inaccuracies as to the parameters RXLEV and RXQUAL corresponding to the various radio terminals, caused principally by diversity and interference with other radio waves.

The timing advance parameter TA is computed in the following manner. A mobile station synchronizes to the BCCH frequency of the server radio station using the FCCH and SCH. In the case of multipath transmission, which occurs mostly in urban environments with many obstacles, the mobile station synchronizes to the signal received most strongly. When it begins to communicate, the radio system 1 estimates the distance travelled by the radio wave between the mobile station and the server radio terminal and transmits the parameter TA to the mobile station.

In the case of multipath transmission, the mobile station correlates to the same signal several times. To synchronize, it chooses the signal that corresponds to the best path in terms of reception level and quality, which is received at a time T2. However, the mobile station also knows the time T1 at which the first correlation with the signal was received. It is therefore possible to define a new parameter referred to as the direct path distance (DCD) between the mobile station and its server radio station: DCD = D(TA) - c.(T2 - T1), where D(TA) is the distance computed from the timing advance TA transmitted by the server radio station and c is the speed of light.

The parameter DCD is a better representation of the actual distance between the server radio terminal and the

mobile station than the timing advance TA. The first signal correlation received may have been attenuated by various obstacles, for example trees, on its propagation path. The strongest correlation received may have been reflected by obstacles of other types, for example the flat facade of a building.

The reception time difference (DIR) of signals from the various radio terminals can equally be used (see the GSM 05.10 - phase 2+ recommendations). The mobile station could compute the reception time difference corresponding to the shortest propagation time of each radio wave, rather than the time for the signal received at the highest power, to avoid inaccuracies associated with multipath transmission. Thus the mobile station could compute the parameter DIR for each adjoining radio terminal.

If the radio terminals are synchronized or if the geographical information server 4 knows the transmit time offset RTD between the various radio terminals, the server will be able to compute the distance relative to the adjoining radio terminal in question. However, the parameter DIR enables the location to be computed precisely only if the radio terminals are strictly synchronized or if the transmit time offset RTD is known and does not drift with time.

A mobile station monitoring a mobile telephone network needs to synchronize to each of the BCCH frequencies of the server cell and the adjoining cells. To this end, it synchronizes to the synchronization burst SCH on the BCCH. A radio wave can take different paths between a radio terminal and a mobile station. This phenomenon is called multipath transmission. In the case of multipath transmission the mobile station correlates to the best path in terms of power and quality, which is not necessarily the shortest path. The number of BCCH frequency correlations received by the mobile station is counted. The mobile

station is therefore able to compute the value of the NB-correlation parameter for each BCCH frequency received and transmit it in the location measurement message. A filter can of course be provided to eliminate correlations corresponding to very poor reception quality.

A mobile station can be enabled to sense if it is moving and, if so, to estimate its approximate speed. The reception time difference DTR is measured by measuring the reception time difference for the same SCH burst of a BCCH multiframe. A BCCH multiframe contains five SCH bursts. Within the BCCH multiframe, an SCH burst is transmitted every 10×8 burst periods (BP) or 11×8 end of BCCH multiframe periods. Because a burst period BP is exactly 15/26 ms, a mobile station that is not moving receives each SCH burst every (10×8×15)/26 ms and one time in five every (11×8×15)/26 ms. A BCCH multiframe is transmitted cyclically. Its transmission time is 51×8×15/26 = 235.38 ms. If t1 is the time the mobile station receives an SCH burst of a BCCH multiframe and t2 is the time the mobile station receives the same burst SCH of a BCCH multiframe transmitted five cycles later, for example, the reception time difference DTR is: DTR = t2 - t1 - t, where t = 5×51×8×15/26 = 1.17692 s. The minimum speed will then be the maximum value of the parameter DTR computed for each of the BCCH frequencies received. If a BCCH frequency has not been received continuously over five multiframes, the mobile station indicates this in the location measurement message.

There are various ways to activate relaying of the location measurement message to the geographical information server, either by automatic activation after entering the telephone number of the geographical information server 4 or by manual activation by the user. The telephone number of the geographical information server 4 can be contained either in the SIM card of the user's

mobile station or in the software of the mobile station. The user can store the telephone number of geographical information servers authorised to locate it. Once the telephone number of the geographical information server has been entered, the mobile station starts to measure the aforementioned parameters. The mobile station can also transmit to the geographical information server the receive levels for the various BCCH frequencies of the cells of the mobile network picked up by the mobile station before call set-up in order to begin the location computation as quickly as possible.

The location measurement message can be transmitted by the mobile station on various frequencies. The mobile station can transmit a location measurement message only when it considers itself able to do so, for example if the parameter DTR reaches a high value.

The mobile station can also transmit location measurement messages only on receiving a request for location information transmitted by the geographical information server in the form of an SMS message or via the GPRS. The location measurement messages can be relayed at predefined intervals, for example every 30 seconds. Finally, the frequency on which the location measurement messages are relayed can be specified in a message transmitted by the geographical information server.

The above possibilities can advantageously be combined. For example, the mobile station can transmit location measurement messages just after the telephone number of the geographical information server has been entered, or if said mobile station has moved, and on receiving a message requesting location information. This can be particularly beneficial if the geographical information server has not succeeded in estimating the position of the mobile station, in particular in the case of erroneous or incoherent data.

The geographical information server may need measurements relating to a particular radio terminal. It then sends a "specific measurement request" SMS or GPRS message to the mobile station specifying the BSIC, BCCH combination for the radio terminal. The mobile station then transmits a "measurement for one terminal" message relating to the radio terminal specified in the specific measurement request message. The measurements contain the BSIC, BCCH combination of the radio terminal, the values RXLEV, RXQUAL, NB-correlation, DTR, NB-cycle, and possibly parameters relating to the distance if the radio terminal in question is a server or if the mobile station knows how to compute the parameter DIR relative to the server cell. The data transmitted between a mobile station and a radio terminal is encrypted to preserve some degree of confidentiality.

That data is not sufficient to compute the position of the mobile station, because the position of the radio terminals constitutes information that is not transmitted over the network but is known to the geographical information server.

The mobile station transmits location measurement messages only in the following situations:

- when a particular telephone number corresponding to a geographical location server is entered;

- when an "authenticated" message corresponding to a location request is received; or

- periodically, to a server identified by the mobile station.

In the latter two cases, the subscriber's SIM card manages transmission of the location measurement messages. Some subscriptions can entail the mobile station being located periodically by a location server. An ad hoc SIMToolkit application has been developed to cover this eventuality and the holder of the SIM card will have been

advised that the mobile station can be located when it is switched on.

Security mechanisms can be implemented to prevent unwanted location. For example, the list of telephone numbers of various geographical information servers can be stored in the SIM card or in the mobile equipment itself.

For improved confidentiality the SIM card of a user can contain an encryption key K which is the same as or different from the key used for encryption in accordance with the GSM recommendation. The mobile station checks the identity of the geographical information server. When the call is set up, the mobile station transmits to the geographical information server a code number RAND. The geographical information server, which holds the user's key K, then computes the code SRES and transmits it in the location information request message. On receiving that message, the mobile station checks if the code SRES corresponds to the code it has computed itself. If so, the mobile station transmits the location measurement message. If not, the mobile station does not transmit and advises the user that an unsuccessful attempt to locate them has been made.

Instead of transmitting the location measurement messages directly, the mobile station can transmit only the BSIC, BCCH combination of the server cell. The geographical information server, which will have recovered the parameter LAI identifying the reception area of the server cell by interrogating a visitor location register (VLR) database covering the area from which the call was sent, can then find out the parameter CGI of the server cell and all the BSIC, BCCH combinations of the adjoining cells and transmit them to the mobile station. The mobile station then checks the accuracy of the information transmitted.

The geographical information server 4 is an expert system which estimates the most probable position or

location area of the mobile station by correlating the parameter values relayed to it and values stored in its database. The parameters stored in the database of the geographical information server are associated with fixed geographical points. The parameters that the geographical information server can use to estimate the position of a mobile station are the reception level and quality, the distance, the various paths taken by a radio wave between a radio terminal and a given point, the motion of the mobile station and the communication time profile of the cell.

The parameter RXLEV corresponds to the receive level of transmissions between the server or adjoining radio terminals and the mobile station. The mobile station knows the downlink parameter RXLEV, i.e. the level at which it receives a transmission from a server or adjoining radio terminal. Even for a mobile station that is not moving at a given location, the parameter RXLEV can be subject to numerous variations, mainly because of fading. A wave of given frequency is very often the resultant of a plurality of signals received with different phases.

The reception quality parameter corresponds to the quality of reception of transmissions between the server radio terminal, and possibly the adjoining radio terminals, and the mobile station. Once again, the reception quality parameter can be subject to many variations, mainly caused by interference between different signals at the same frequency, brought about by the re-use of the same radio frequency by other radio terminals, or fading. Accordingly, the greater the number of calls at a given time, the more likely the reception quality is to be poor.

Frequency hopping improves reception quality by changing the frequencies employed, except for the BCCH frequency, in a pseudo-random fashion. The map may need to take account of such frequency changes.

The distance between the mobile station and its

server radio terminal is estimated either from the timing advance TA or from the direct path distance DCD. The distance to the adjoining radio terminals can be estimated, if necessary, from the reception time difference parameter DIR if the radio terminals are synchronized or if the geographical information server knows the transmission time offset RTD for each radio terminal. In this case, the geographical information server SIG can compute the observed time difference parameter OTD = DIR + RTD. The distance to the adjoining cells could be computed from the formula D = Do + Cx (OTD), with Do = distance computed using the parameter TA or Do = DCD, and from C, the speed of light.

The parameter NB-correlation corresponding to the number of BCCH frequency correlations between a radio terminal and a mobile station is associated with each of the geographical points and each cell. The value of this parameter depends greatly on the topology of the terrain. Entered in the database of the geographical information server, this value can be computed by the radio planning tool 5, possibly in conjunction with physical measurements (see figure 3). In the case of values from the network planning tool, the pertinence of the values computed depends on the quality of the digitized topology, which can be improved by comparing the actual measurements and the computed measurements.

For a given call, the value of the parameter RXLEV and, most importantly, the value of the parameter RXQUAL depend on the number of simultaneous calls at the server radio station and its adjoining radio stations. It is possible to establish traffic time profiles as a function of place, day and time. Statistics processed by the various operational control centres 2 enable the network operators to establish a traffic time profile for the various sites processed by the geographical information server 4. For

example, the traffic at radio terminals covering a football stadium will be much greater on a match day.

A time profile system 7 (figure 4) can be interfaced to the geographical information server to define the time profile concerning the simultaneous traffic of each radio terminal. The time profile system can draw information from operational control centre statistics or network management centre statistics or statistics entered manually. The time profile for each radio terminal depends on the day (business day or weekend), time, special days and other events.

The geographical information server receives the calls transmitted by it and processes the location parameters associated with the call.

Because of its interface with the operational control centres 2 or the network management centre 3, the geographical information server knows the parameter CGI of the server cell and the corresponding relationship of the (BSIC, BCCH) combinations of all the cells adjoining the server cell with their respective parameter CGI, the exact geographical location of each radio terminal of the network (in three dimensions to allow for the height of the antenna of the radio terminal), the transmit power of each radio terminal of the network, the transmit frequency of each radio system: GSM 900, Extended GSM, DCS (or GSM) 1800, PCS 1900, or any other type of frequency, a parameter indicating if frequency hopping and EFR (Enhanced Full Rate) are activated or not for each radio terminal, and the exact geographical location of each fixed point modelled, in three dimensions. The enhanced full rate (EFR) option improves transmission quality on the radio channel through improved radio channel transcoding, which has been standardized. Note that the EFR option is activated for each call only if the mobile station is capable of supporting that option. The EFR option is processed

similarly to frequency hopping: the frequency is the same and activating this option improves quality on the radio channel.

Using its interface with the radio planning tools, or manual measurements, the geographical information server knows the estimated reception and quality levels of each BCCH frequency received by a modelled geographical point and the number of paths that a radio wave can take between a radio terminal and a digitized point. The interference, quality, reception level values and the number of paths estimated are stored in the geographical information server before calling the mobile station.

The geographical information server uses the above information to compute estimated values off-line. However, it must take into account operational constraints, in particular for some radio parameters which depend on the network, in particular the corresponding relationship between the BSIC, BCCH combination and the CGI, the power level of each radio terminal and whether frequency hopping is active or not.

Through an interface with the network supervision means, preferably a standardized Q3 interface, the geographical information server is kept up-to-date in real time on any changes to the parameters, in order to take account of the changes in evaluating the position of the mobile station. The geographical information server also takes into account the operational status of a radio terminal, in particular in the event of a breakdown. Similarly, if the transmit power of a radio terminal is changed, the geographical information server can arrive at a first approximation by considering the ratio between the receive power at a given geographical point and the transmit power of the radio terminal, considered to remain the same.

On receiving a location measurement message, the

geographical information server computes the CGI of all the cells involved in relaying measurements by means of the CGI of the server and the BSIC, BCCH combination of all the adjoining cells.

It then estimates the most probable area in which the mobile station is located from the information on distance, receive level, reception quality and number of correlations between the mobile station and the various adjoining radio terminals. The estimate is obtained by comparison with previously stored values in accordance with rules defined by an expert system. In absolute terms, too much information is relayed to the geographical information server. However, allowance must be made for the fact that some parameters may be incorrect. The expert system is capable of discarding inconsistent parameters and computing the location from the other parameters.

On receiving the parameters, an inference engine starts a consultation and uses the rules of logical reasoning to make deductions leading to the location of the mobile station. The location estimated by the geographical information server is different according to whether the mobile station is stationary or moving. The mobility of a mobile station can be evaluated from a number of indices: change of server radio terminal, high frequency of relaying location measurement messages, the parameter DTR, etc.

If the mobile station is not moving, the geographical information server has the time to compute a more accurate location and can use all of the parameters available to it.

For a set of values available to the geographical information server corresponding to a call, i.e.:

- {RXLEX}, the set of geographical points of a topology corresponding to the values RXLEV for the various radio terminals concerned,

- {RXQUAL}, the set of geographical points of a

topology corresponding to the values RXQUAL for the different radio terminals concerned, and

- {distance}, the set of geographical points corresponding to the estimated distance from the server radio station,

the geographical information server then conforms to rules of logical reasoning, of which the following are examples:

Rule 1:

If the intersection between the aforementioned three sets enables a point to be determined, then the location of the mobile station has been found.

Rule 2:

If the intersection of the sets {RXLEV} and {RXQUAL} yields several points and if the distance estimated from the timing advance TA yields a set of points farther from the server radio terminal than those previously found, then the timing advance TA definitely corresponds to multipath transmission. The parameter TA must therefore be ignored.

Rule 3:

If the parameter relating to the distance supplied to the geographical information server is the direct path distance DCD the estimate is more reliable than that based on the timing advance TA. The geographical information server begins its search with points corresponding to the parameters DCD and then correlates them with points obtained using the parameters RXLEV and RXQUAL.

Rule 4:

If the set of geographical points found is near a radio terminal and the latter does not appear in the location measurement message, the geographical information server checks if the radio terminal is active, using the interface with the operational control centre or the network management centre. If the radio terminal is inactive then the location has been found. If not, the

geographical information server sends the mobile station a specific measurement request message specifying the BSIC, BCCH combination of the radio terminal in question. The mobile station transmits a location measurement message to the radio terminal in question. The geographical information server then determines if the computations are correct.

In the case of a mobile station that is moving, the geographical information server does not have time to use all the parameters available to it. The geographical information server estimates a displacement index DPT which is the maximum reception time difference DTR in order to be able to estimate the minimum speed at which the mobile station is moving. The geographical information server uses the identifiers of the radio terminals received by the mobile station (CGI and BSIC, BCCH combination) and the distance to the server radio station to arrive at a first estimate of the location of the mobile station.

If no location measurements have reached the geographical information server, it begins the same location process as for mobile stations which are stationary. Otherwise, the geographical information server estimates the position of the mobile station from the difference between the values relayed to it.

The parameters used are the identifier CGI of the server radio terminal, the identifier of the adjoining radio terminals (computed from their BSIC, BCCH combination), the distance to the server radio terminal and the geographical information server's map. Because a mobile station cannot move at high speed except on main roads and railways, the geographical information server contains a vector map so that it can take roads and rail routes into account in estimating the location. The geographical information server uses expert system rules.

The following three rules are examples of such

rules:

Rule 1:

In the case of handover between relaying of two parameter values, the geographical information server can estimate the position of the mobile station from geographical cross-checks, a vector map, the time that has elapsed between relaying the two parameter values and the parameter DPT. If the parameter DPT yields an estimate of the speed of the mobile station of at least 40 kph, the time between relaying the two measurements is 20 s, the circular arcs marking the distance range between the mobile station and the two radio terminals at the two relaying times are contiguous, and if more than one route exists at the place where the two circular arcs are contiguous, then there is every chance that the mobile station is located at that point.

Rule 2:

Depending on the speed of the mobile station estimated from the parameter DPT, the geographical information server knows the road or rail routes on which the mobile station is likely to be. For example, if the estimated speed of the mobile station is of the order of 250 kph, the user is very likely to be on a high-speed train, whose route can be recognised by the geographical information server.

Rule 3:

If no value is relayed for a relatively long time period, for example 15 seconds, the geographical information server starts the fixed station location procedure.

The above mobile telephone location system can be used to broadcast geographical information related to the exact place from which a call was sent. The information is broadcast with the agreement of the publishers of geographical information and available only to subscribers

of the mobile telephone network or to those who have purchased the service. The broadcast language can correspond to the telephone number, which can be the same in all networks. The geographical information can be of any kind: cultural, touristic, gastronomic, meteorological, commercial, etc. If the geographical information server estimates that different locations may be confused, it can propose commentaries relating to different sites to be chosen by the user or send the mobile station a "location information request" message.

The above location system can also be used for navigation or in an emergency. A probable area in which the mobile station is located can be highlighted on a digital map at the geographical information server. An operator can then provide guidance to the user, or download information for the user to display, or locate the source of a distress call. The position relative to the radio terminals can be computed relative to radio terminals of different mobile telephone networks.

The telephone carrier can use the location system to offer fixed/mobile convergence services, either to apply special charges to all calls transmitted from near the user's home, or to cause mobile and fixed calls to converge.

In the former case, the mobile station transmits "charging measurement" messages to a charging centre via the traffic logical radio channel. The location measurement message contains the date and time at which the call started, its duration and the identifier of the mobile subscriber. If it cannot transmit its message, for example because the network is overloaded, it can store it to transmit it as soon as possible.

The mobile station sends a "charging measurement" message during a conversation only in the following three situations: incoming or outgoing call effected in the home

area, exit of the mobile station from the home area during the conversation, entry of the mobile station into the home area during the conversation.

In the case of fixed/mobile convergence as such, a mobile station entering the perimeter of the home of the subscriber transmits a transfer to fixed message via the traffic logical radio channel to a switching centre. Thereafter an intelligent network system modifies the routing of calls so that the mobile station and the fixed station of the subscriber "are one and the same": outgoing calls can be transmitted from the fixed station or from the mobile station of the subscriber and incoming calls are notified on the fixed station and the mobile station of the subscriber. Of course, the mobile station does not need to be communicating to transmit the transfer to fixed message, given that the GSM standard provides that any mobile station that is switched on performs reception measurements in the "idle" mode.

In the case of a family with a number of mobile telephone subscriptions but only one fixed telephone subscription, the mobile subscriptions can converge towards a single fixed subscription.

On leaving the home area, the mobile station transmits a "cancel transfer to fixed" message to the switching centre. The effect of this message is to separate the convergence between the mobile station and the fixed station.

Transmission of transfer to fixed messages can be deactivated manually.

There are two different ways to activate fixed/mobile convergence at a mobile station.

The first solution is as follows: when the owner of the mobile station is at home, they can call a server in order to transmit a location measurement message. The server receives the data and compares it to the values in

its database. If the data is consistent, the server transmits a message to the mobile station to advise it that the data transmitted corresponds to its home. The server also transmits the correspondences between the BSIC, BCCH combinations and the cell global identifier CGI of the adjoining cells. GSM technical specifications 11.11 and 11.14 provide for the mobile station to store the cell global identifier CGI of the cells that the mobile station of the subscriber picks up at home, their associated BSIC/BCCH combination, and their reception level, computed in the subscriber's SIM card.

A second solution is for a data processing server to download into the mobile station, via a traffic logical channel, the cell global identifier CGI of the cells that the mobile station of the subscriber picks up at home, their associated BSIC/BCCH combination, and their estimated reception level. GSM technical specifications 11.11 and 11.14 provide for the mobile station to store the values transmitted by the data processing server in the subscriber's SIM card.

In the event of a change of frequency plan on the mobile network, the correspondence between the cell global identifier CGI and its associated BSIC/BCCH combination changes. In this case, the data processing server downloads the values described in the previous paragraph before the frequency plan is implemented and the subscriber's SIM card contains the two sets of computations that can be used to compute if the subscriber is within the perimeter of their home. Those values will have been computed by the radio planning tool available to the carrier.

Similarly, in the event of a change of transmit power of a radio system covering the subscriber's home, the data processing server downloads the new associated reception levels "in real time".

Finally, if a cell within the perimeter of the

subscriber's home is added, removed or breaks down, the data processing server downloads the new associated reception levels "in real time".

To perform its computations and to estimate if it can transmit a charging measurement, transfer to fixed or cancel transfer to fixed message, the mobile station has the cell global identifier CGI, the associated BSIC/BCCH combination, and the associated reception level for each of the cells within the perimeter of the subscriber's home. It is important for the SIM card to hold all the cell global identifiers CGI because the cell carrying a call transmitted from the subscriber's home will not necessarily always be the same one. A mobile station knows only the cell global identifier of the cell carrying the call and the relative identification of the adjoining cells, i.e. their BSIC/BCCH combination.

The software on the SIM card of the mobile station computes if it is within the perimeter of the home in the following manner: it searches if the cell global identifier CGI carrying the call in progress is stored in the SIM card. If it is, it compares the reception level values computed by the mobile station with those stored in the SIM card for the server cell and the adjoining cells identified by their BSIC/BCCH combination. Of course, the SIM card software applies a margin of error in order to take account of the multiple inaccuracies already described. If more than one set of values is stored in the SIM card, the software in the SIM card uses all the sets of values to carry out this comparison.

Outside the perimeter of the home, the mobile station does not transmit any message associated with fixed/mobile convergence. The mobile network subscriber therefore knows that they will be located "without knowing it" only when they are within the perimeter of their home.

CLAIMS

1. A system for locating mobile telephones adapted to communicate with a first radio terminal of a network of radio terminals supervised by an operational control centre, the mobile telephone including means for estimating at least one parameter representative of the position relative to a terminal, and means for transmitting information relating to said parameter to a server via the first radio terminal, and the server including means for comparing the information relating to said parameter to a predefined map of said parameter and deducing therefrom an estimate of the location of the mobile telephone, characterized in that, information being transmitted between a mobile telephone and a radio terminal on a service logical channel and on a traffic logical channel, the information relating to said parameter is transmitted to the first radio terminal on the traffic logical channel.

2. A system according to claim 1, characterized in that it includes means for estimating the distance between a mobile station and the first radio terminal with a margin of error Δd_{bm} as a function of the time taken by a wave to cover said distance.

3. A system according to either preceding claim, characterized in that it includes means for estimating the levels of reception from the first radio terminal and adjoining radio terminals.

4. A system according to any preceding claim, characterized in that the mobile station includes means for comparing the times r_i of reception by the mobile station of transmissions from other radio terminals at times r of reception of transmissions from the first radio terminal and deducing therefrom the value Δr_i of the receive time shift and means for transmitting the value of each time shift Δr_i to the server via the first radio terminal and the server advantageously includes means for estimating the

distance between the mobile telephone and each of the other radio terminals as a function of the time shift Δr_i and the time shift Δe_i between the transmission times e_i of the other radio terminals and the transmission times e of the first radio terminal.

5. A system according to any preceding claim, characterized in that it includes means for specifying the location of the mobile telephone by cross-checking the estimated locations obtained using at least two parameters.

6. A system according to any preceding claim, characterized in that location can be effected at the command of the mobile station user.

7. A system according to any preceding claim, characterized in that the server can include means for transmitting information to the user as a function of the location of the mobile telephone.

8. A system according to any preceding claim, characterized in that the map can be adapted to the transmit power levels of the various radio terminals by linear interpolation.

9. A system according to any preceding claim, characterized in that the map can be recomputed as a function of changes in parameters likely to modify the values relayed to the geographical information server, for example as a function of activation or non-activation of frequency hopping on the various radio frequencies.

10. A system according to any preceding claim, characterized in that the mobile station includes means for comparing location data with a previously stored area, for specific charging, the location data being stored in a SIM card of the mobile station.

11. A system according to claim 10, characterized in that the mobile station can include means for transmitting charging data by means of the short message service.

12. A system according to claim 11, characterized in that the mobile station transmits charging data if a call is made or received in the vicinity of the previously stored area if the mobile station enters or leaves said previously stored area during a call.

13. A system according to any of claims 10 to 12, characterized in that the mobile station includes means for transmitting a "transfer to fixed network" message if said mobile station is in the previously stored area, causing modification of call routing so that any incoming call is notified to the fixed station or stations and to the mobile station.

FIG.1

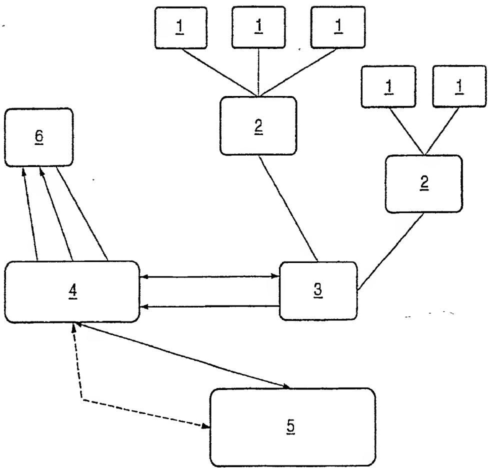


FIG.2

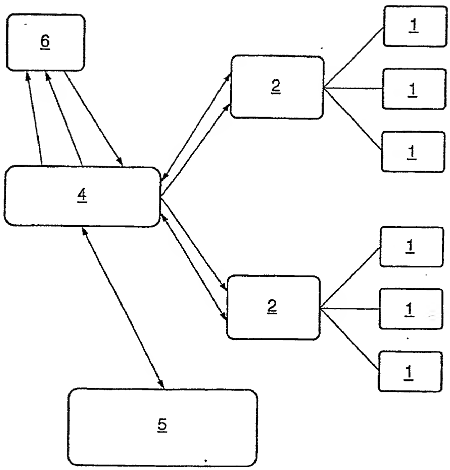


FIG.3

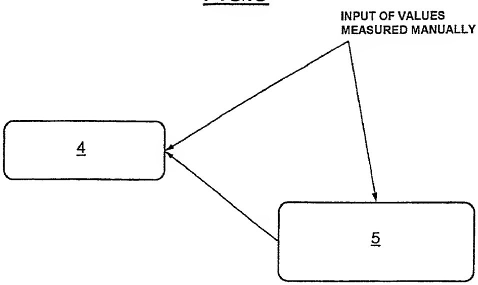
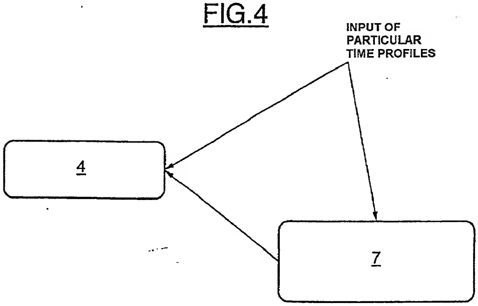

INPUT OF VALUES
MEASURED MANUALLY
4
5

FIG.4


INPUT OF
PARTICULAR
TIME PROFILES
4
7

DECLARATION AND POWER OF ATTORNEY
UNITED STATES PATENT APPLICATION

Attorneys' Docket

As a below named inventor, I declare that:
My residence, post office address and citizenship are stated below to my name.
I believe I am the original, first and sole inventor (if only one name is listed below), or an original first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which patent is sought on the invention entitled :

System for locating mobile telephones.

(check one) ( ) is attached hereto
( ) was filed as U.S. Application No. on
and (if applicable) was amended on
(X) was filed as PCT International Application No.PCT/FR99/01693 on 9 July 1999
and (if applicable) was amended under PCT Article 19 on

(I authorize any attorney appointed below to insert information in the preceding blanks.)

I have reviewed and understand the contents of the above-identified specification, including the claims , as amended by any amendment referred to above.
I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119(a)-(d) or §365(d) of any foreign and PCT application(s) for patent or inventor's certificate, or §365(a) of any PCT international application which designated at least one country other than the United States of America listed in this Declaration.
I have also identified below any foreign application for patent or inventor's certificate or PCT international application having a filing date before that of the application(s) on which priority is claimed.

Foreign/PCT Appln. N°	Country	Filing Date	Priority Claimed (Yes / No)
98 08929	France	10 July 1998	Yes

I hereby claim the benefit under Title 35, United States Code §120 or §365(c) of any United States application and PCT international application designating the United States listed in this Declaration and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, §112. I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application :

U.S.Application N°	Filing Date	Status (patented/pending/abandoned)

I hereby claim benefits under Title 35 United States Code §119(e) of any U.S.provisional application(s) listed below :

U.S.Provisional Appln.N°	Filing Date

I hereby appoint the following attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith Robert G.Weilacher (20531), Herbert M.Hanegan (25,682), Dale Lischer (28,438), Frederick F.Calvetti(28,557),J.Rodgers Lunsford III (29,405), Michael A.Makuch (32,263) Dennis C.Rodgers (32,936) William F.Rauchholz (34,701), Michael C.Carrier (42,391), Eric J.Hanson (44,738), Patrick R.Delaney (45,338), Donna D.King (45,962), Jospeh M.Lewinski (46,383) and Brandon S.Boss (46,567

14.

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I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true ; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code; and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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